perature of 180–230 °C granules, beads or crushed polystyrene, pre-mixed with plasticizer (medical white oil), pigments, dyes, fillers, modifying additives. Then the colored polystyrene is dissolved by mixing with a plasticizer-a mixture of styrene oligomers and methylmetacrylate.

This effect is achieved due to the fact that, unlike the one known in the proposed method for producing polystyrene paint: - happens a better distribution of pigments, dyes, fillers and various additives in painted polystyrene by extrusion at a temperature of 180–230 °C pre-moistened with a plasticizer surface of polystyrene in the form of beads, granules fragmentation or Dissolution of painted polystyrene in solvents provides a fairly complete homogenization paint, Besides reducing the content of volatile substances at the stage of drying and shorter time to receive the finished product; the aggregate of processes leads to improvement of physico-mechanical and operational performance.

To achieve this effect by directly increasing the concentration of polystyrene or the introduction of modifying additives is impossible, because the viscosity of the paint increases, which makes it difficult to process and apply to the surface. The properties of obtained dyes, the relevant Standards of external works at colouring of timber, concrete and metal.

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3D PRINTED BIOCOMPATIBLE POLYLACTIDE – CALCIUM PHOSPHATE BASED MATERIAL FOR BONE IMPLANTS

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Introduction

For regenerative medicine, however, there are still areas, in which the implants fabricated from calcium-phosphate ceramics are almost irreplaceable [1, 2]. The lack of the full geometric congruence between the implant and adjacent tissues leads to the local rejection of the implant in zones with low mutual integration, which, in turn, results in the undesirable fibrous tissue formation there [1, 2]. Consequently, there is a strong demand in the implants that will perfectly fit in the bone defects and the technology capable of producing such implants with a required precision. Therefore, the further increase of the calcium-phosphate mass ratio in the composite is expected to normalize the pH level of body fluids interacting with bones and stimulate the implant resorption during the new bone growth.

Materials and methods

The desired composite material was obtained by mixing commercially available lactic acid polymer (Natural Works Ingeo 40–43d, NatureWorks LLC, USA) with HAP obtained by sedimentation method described in [1]. In order to perform the compressive strength tests and fatigue tests until the final fracture, 10 cubic samples with the side of 10 mm were printed for each material composition. In addition to that, 20 bar samples with the size of 10×10×55 mm were fabricated for the flexural strength tests as well as for the Charpy impact tests. Finally, to predict the material behavior inside the body, the composite wettability by an isotonic solution (9 % NaCl) was studied by using a system KRUSS DSA30.

Result and discussion

Figure 1 presents the strength characteristics of the samples obtained under optimized printing conditions. The compression and flexural strengths of the samples improve correspondingly from 54±2 MPa to 62±2 MPa and from 42±2 MPa to 46±2 MPa (i.e. on 15 % and 10 %, respectively) when HAP content is increased from 5 % to 30 %. Charpy impact tests indicate the samples impact strength increase on 27 % and vary from 4.4±0.1 kJ/m^2 to 5.6±0.1 kJ/m^2 depending on the exact material com-

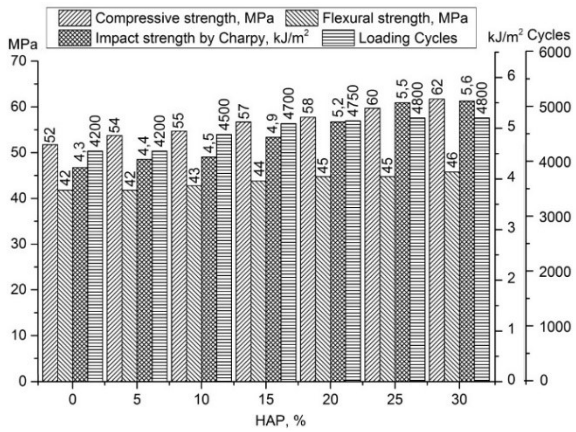

Fig. 1. *The mechanical properties of the studied samples with respect to the pure PLA*

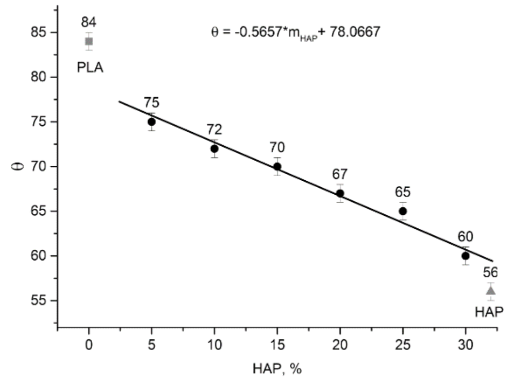

Fig. 2. *The limiting contact angle for the composites wetted by an isotonic solution*

position.

Figure 2 presents the wetting angle θ for the studied composites as a function of HAP content m_{HAP}, with pure PLA material (84±1°) and HAP based ceramics (56±1°) marked as reference points. The wettability of pure PLA by physiologic fluids is very low with the limiting angles reported in literature lying in the range of 84°–95° [2].

Conclusions

In this work, the composite biocompatible material based on PLA and HAP was developed, fabricated and analyzed. The synthesis of the initial composite powder and its processing into the filament suitable for the additive manufacturing was described in details. The optimized extrusion and printing parameters were also evaluated and discussed for a range of composites with the mass fraction of HAP varying from 5% to 30%. Overall, the obtained data indicated that combining HAP with PLA within a single material ensured the synergy of the physical, chemical and mechanical properties of both initial components. Thus after the successful clinical trials, the composite and fabrication approach described in this work could be implemented in the regenerative medicine for the production of implants with any arbitrary shapes.

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THE METHOD OF NMR FOR INVESTIGATION OF LIQUID-LIQUID EQUILIBRIUM IN ETHANOL – FORMIC ACID – ETHYL FORMATE – WATER SYSTEM

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Development of coupled processes (these processes combine phase transition and chemical reaction) for chemical technology requires detailed information on structure and features of phase diagrams of reacting systems since phase transition that takes place during synthesis can complicate and fundamentally change realization of technological process. For example, to organize industrial synthesis of esters, it is necessary to take into account location of the heterogeneity region on phase diagram (its presence is explained by the limited mutual solubility of ester and water), since kinetics of syn-